United States Department Of Agriculture | Forest Service | Shasta-Trinity National Forests

Reply To: 3420 Lat 41.79638 Lon -123.37482 Date: November 13, 1989

Subject: Evaluation of Current Mortality Situation on Happy Camp RD, Klamath NF (Rept. No. N89-24)

To: Forest Supervisor, Klamath NF

Personnel on the Happy Camp RD were concerned about an increase in the number of fading trees on the District. Of particular concern were the large number of dying sugar pine and the need to anticipate future mortality to efficiently schedule salvage sales. Areas on the District that burned during 1987, as well as areas unaffected by fire, were examined on September 28, 1989 by Dave Schultz and Gregg DeNitto from the Forest Pest Management Northern Service Area, and Dave Hartman and Matt Reudy from the District.

Most of the Happy Camp RD consisted of old growth stands prior to the fires of 1987. At elevations under about 4,000 feet, Douglas-fir and sugar pine are the predominant conifers with small amounts of ponderosa pine, incense-cedar, and white fir. Hardwoods are locally abundant. Roughly half of the District burned, to some degree, in 1987. The intensity of the burn varied from complete destruction of all vegetation to a fairly light ground fire which left the tree cover virtually intact. Areas which burned severely have already been salvaged and planted.

Current mortality is higher than normal outside the areas that burned. All species and size classes of trees are involved in the current mortality. Douglas-fir accounted for a high percentage of the dead trees, which may simply reflect the species composition of the stands. The immediate cause of death of the Douglas-fir were infestations of the Douglas-fir engraver, Scolytus unispinosus, in the portions of trees with thin bark and infestations of the fir flatheaded borer, Melanophila drummondi, in the thicker barked portions. Conditions which made it possible for so many trees to become infested include heavy stocking in places, advanced age of some trees, and several years of low precipitation.

The second largest amount of mortality on the District involved sugar pine. Sugar pine generally comprises about 30 percent of the old growth stands, and in some areas it makes up a disproportionately high percentage of the mortality. The beetles infesting dead sugar pine include the mountain pine beetle, Dendroctonus ponderosae, the California flatheaded borer, Melanophila californica, and several species of pine engravers, Ips spp. Stand and environmental factors that contributed to sugar pine mortality are the same as those involved in Douglas-fir mortality. Sugar pine mortality was probably proportionally higher than other tree species because the mountain pine beetle was involved.

The flatheaded borers are usually successful only in trees which are severely declining in vigor. They do well in trees stressed by drought but must depend on diseased or damaged trees during periods of normal precipitation. The adults do not bore into trees, but merely lay eggs in bark crevices. The larvae must bore through the bark on their own. Larval mortality is high in healthy trees. The life cycle can be completed in as little as a year, but a period of several years is more common. The level of mortality associated with these beetles is more a reflection of host condition than of beetle population levels.

The engraver beetles are capable of breeding in thrifty trees, but they normally do not cause much mortality unless a population has built up in slash or blowdown.

The mountain pine beetle breeds exclusively in standing trees and is capable of killing healthy trees. Successful attacks are often initiated on a tree which is under stress. As the mountain pine beetle bores into a host tree, it releases a pheromone which draws more beetles into the area. Once they are close to the tree under attack, the beetles will attempt to bore into it, and the adjacent host trees. If the adjacent trees are in a weakened condition, or the beetles are numerous, it will result in a group of dead trees. In low elevation sugar pine in California there can be a summer generation and an overwintering generation of mountain pine beetle. Sugar pine mortality is proportionally higher than that of other tree species because multiple generations per year allow the mountain pine beetle population to increase rapidly, and the ability to make mass attacks can overcome the defenses of some reasonably healthy trees.

Mortality in areas affected by fire during 1987 is slightly higher than in unaffected areas of the District, but otherwise conditions are very similar. Although competing vegetation was eliminated by ground fires in some areas, the fire also partially girdled some trees. The higher level of mortality in the burned areas included both trees which were stressed from a combination of drought and minor fire injuries, as well as trees which had major cambial damage caused by fire. Although some burned areas had little crown damage, the ground fire was hot enough to comsume the duff layer. Some trees that still have a green crown have been almost, or completely, girdled at the soil line. The fire was hot enough to kill a band of phloem in these trees, but left the xylem tissue functional. This allows the roots to supply water to the crown but carbohydrates can not travel back to the roots. As the roots slowly starve, these trees become increasingly susceptible to attack by a variety of bark beetles, engraver beetles and borers.

Flatheaded borers are involved in much of the current mortality on the District. Because the borers can have long life cycles, some trees may not die until 3 or 4 years after they have been infested. There are a large number of currently infested trees on the District which will not fade until 1990 or later. Regardless of the amount of precipitation received this winter, the number of trees that fade during 1990 should be about the same as the number that faded during 1989. Mortality should begin to taper off in the unburned areas during 1991 if precipitation is normal, or above normal, this winter. A fairly high level of mortality will persist in some of the burned areas until the population of trees with severe cambial damage has been depleted.

There are relatively few signs that can be used to identify the currently infested trees before their crowns fade. Conspicuous pitch tubes are usually produced in response to mountain pine beetle attacks on sugar pine. Most of the sugar pine under current attack by mountain pine beetle on the District are under enough moisture stress that the only response is either tiny, inconspicuous pitch tubes in bark crevices, or dry, red boring dust. The external symptoms of flatheaded borer infestations tend to be difficult to detect under the best of circumstances. The boring activities of the larvae sometimes cause drops or small streamers of clear resin on the tree bole. Most of the older trees on the District have enough lichen on the bark to make detection of resin drops or streamers quite difficult. A sign which may be more visible during late winter or early spring is evidence of feeding by woodpeckers.

## Management Alternatives

1. Do nothing. About the same number of trees will fade during 1990 as during 1989. If precipitation reaches normal or above normal this winter, mortality will taper off over a period of several years. If precipitation is below normal this winter, mortality will remain high through 1991 and possibly beyond. Some old growth overstory aggregations are beginning to show signs of decline. These aggregations will experience high mortality during future periods of drought. Old growth trees will not be eliminated, but the overstory of some stands may become quite sparse. Hardwoods are likely to dominate some future stands.

2. Salvage and Sanitize Stands. The major effect of salvaging dead trees would be to recover the value of the wood. Depending upon the size of the openings created and the amount of mineral soil exposed during harvesting, there may be some increase in natural regeneration. Salvage activities in Douglas-fir might result in slightly increased mortality in residual Douglas-fir for several years because of site disturbance and additional stress on the leave trees. A temporary, localized reduction in sugar pine mortality may be achieved by reducing mountain pine beetle populations if control efforts are extremely intensive. To achieve a population reduction of mountain pine beetle, all infested sugar pine including submerchantable trees and green trees under attack would have to be removed in a block of at least a quarter section in size. As long as suitable mountain pine beetle habitat has not been altered, the population reduction would be expected to last for only one generation, which could be less than six months at lower elevations. Even if attacks by mountain pine beetle were eliminated, some sugar pine mortality would still occur due to attacks by insects such as the California flatheaded borer, which are unlikely to be affected by salvage logging. Salvage operations which harvest only along existing transportation systems and remove only commercial trees would not be expected to remove enough mountain pine beetles to lower future sugar pine mortality.

To the extent that trees likely to die in the near future can be identified and removed, mortality can be reduced for a few years. The removal of the equivalent of several years of salvage in a single sanitation harvest would also have the benefit of reducing the amount of site disturbance. After the passage of a few years, mortality would be at the same level as the Do nothing alternative.

3. Re-examine burned areas. There are some trees in the burned areas which still have green foliage, but also have enough cambial damage that they will die. Some of the damage is not immediately obvious and requires chopping some bark to determine the extent of the injury. Guidelines contained in PSW Miscellaneous Paper No. 60: Guidelines for Estimating the Survival of Fire Damaged Trees in California by Willis Wagener, can be used to identify trees which have a low probability of long-term survival. Even on trees which have no visible crown damage, cambial killing above stump height is considered severe on all species. Cambium killing at ground level involving more than 25 percent of the circumference on ponderosa pine, Douglas-fir and white fir, or basal girdling of more than 60 percent on sugar pine are also considered severe.

Removal of severely injured ponderosa or sugar pines before they come under attack by bark beetles can prevent the development of bark beetle group kills involving adjacent trees of the same species. The major benefits of identifying trees likely to die and removing them in a single operation would be greater efficiency and a reduction in the number of stand entries.

4. Manage old growth stands. Old growth stands on the District developed under the influence of relatively frequent fires. Fire protection for about the last 80 years has allowed the development of a dense understory of hardwoods and shade tolerant conifers. The understory competes with the overstory for soil moisture, as well as creating a large fuel load. The overstory in many old growth aggregations is showing signs of decline. Where the old growth overstory has a high resource value, it may be possible to extend the life of some stands which have not deteriorated too far. This would require a reduction in some of the understory vegetation to make more soil moisture available to the overstory. Prescribed fire might be used to maintain an open condition, but a lot of hand work would be needed initially to deal with the amount of fuel present. In stands where there has already been considerable deterioration of the overstory, it may be more feasible to regenerate the stands.

If you have any questions about this evaluation or would like to discuss the alternatives, please call Dave Schultz or Gregg DeNitto at (916) 246-5087.

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